Appendix *- Glossary of Terms

Existing/Current Condition – Observed, qualitative and quantitative measures we used to describe density, Metrics are used to describe the existing condition. from planned AND unplanned actions taken over the last 150 years. in combination with the natural disturbance process on forested conditions. Some of the actions include (but aren't limited to) grazing, logging, fire suppression/exclusion, wildfires and insect and disease outbreaks.

Fire Severity- The effect a fire has on mortality of overstory trees and ranges fr

Historic Range of Variation (HRV) – HRV of ecological conditions can be defined as the variation of historical ecosystem characteristics and processes over time and space scales that are relevant to land management decisions.This definition emphasizes that HRV describes a body of knowledge about historical ecological conditions without any explicit prescription for how that body of knowledge should be applied to land management decisions.

Seral stage (status): a stage of secondary successional development (secondary succession refers to an ecological process of progressive changes in a plant community after stand-initiating disturbance). Four seral stages are recognized: potential natural community, late seral, mid seral, and early seral (Hall et al. 1995).

- Early Seral: clear dominance of seral species (western larch, ponderosa pine, lodgepole pine, etc.); PNC species are absent or present in very low numbers.
- Mid Seral: PNC species are increasing in the forest composition as a result of their active colonization of the site; PNC species are approaching equal proportions with the seral species.
- Late Seral: PNC species are now dominant, although long-lived, early-seral tree species (ponderosa pine, western larch, etc.) may still persist in the plant community.
- Potential Natural Community (PNC): the biotic community that one presumes would be established and maintained over time under present environmental conditions; early- or mid-seral species are scarce or absent in the plant composition.

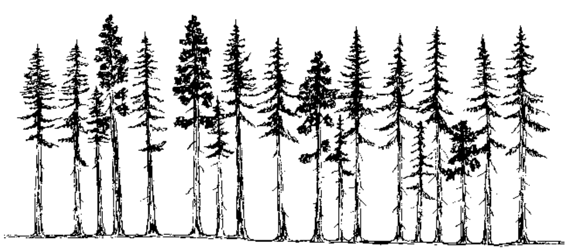
Structural stage (class): A stage or recognizable condition relating to the physical orientation and arrangement of vegetation; the size and arrangement (both vertical and horizontal) of trees and tree parts. The following structural stages have been described (O'Hara et al. 1996, Oliver and Larson 1996):

- Stand initiation: one canopy stratum of seedlings and saplings is present; grasses, forbs, and shrubs typically coexist with the trees.
- Stem exclusion: one canopy stratum comprised mostly of pole-sized trees (5-8.9" DBH) is present. The canopy layer may be open (stem exclusion open canopy) on sites where moisture is limiting, or closed (stem exclusion closed canopy) on sites where light is a limiting resource.
- Young forest multi strata: three or more canopy layers are present; the size class of the uppermost stratum is typically small trees (9-20.9" DBH). Large trees may be absent or scarce.
- Understory reinitiation: two canopy strata are present; a second tree layer is established under an older overstory. Overstory mortality created growing space for the establishment of understory trees.

- Old forest: a predominance of large trees (> 21" DBH) is present in a stand with one or more canopy strata. On warm dry sites with frequent, low-intensity fires, a single stratum may be present (old forest single stratum). On cool moist sites without recurring underburns, multi-layer stands with large trees in the uppermost stratum may be present (old forest multi strata).

Table 1. Description of Forest Structural Classes By Developmental Stage and Size.

Stand Initiation (SI). Following a stand-replacing disturbance such as wildfire or timber harvest, growing space is occupied rapidly by vegetation that either survives the disturbance or colonizes the area. Survivors literally survive the disturbance above ground, or initiate growth from their underground roots or from seeds stored on-site. Colonizers disperse seed into disturbed areas, the seed germinates, and then new seedlings establish and develop. A single canopy stratum of tree seedlings and saplings is present in this class.



Stem Exclusion (SECC or SEOC). In this stage of development, vigorous, fast-growing trees that compete strongly for available light and moisture occupy the growing space. Because trees are tall and reduce sunlight, understory plants (including smaller trees) are shaded and grow more slowly. Species that need sunlight usually die; shrubs and herbs may become dormant. In this class, establishment of new trees is precluded by a lack of sunlight (stem exclusion closed canopy) or of moisture (stem exclusion open canopy).

Understory Reinitiation (UR). As a forest develops, new age classes of trees (cohorts) establish as the overstory trees die or are thinned and no longer fully occupy growing space. Regrowth of understory vegetation then occurs, and trees begin to develop in vertical layers (canopy stratification). This class consists of a sparse to moderately dense overstory with small trees underneath.

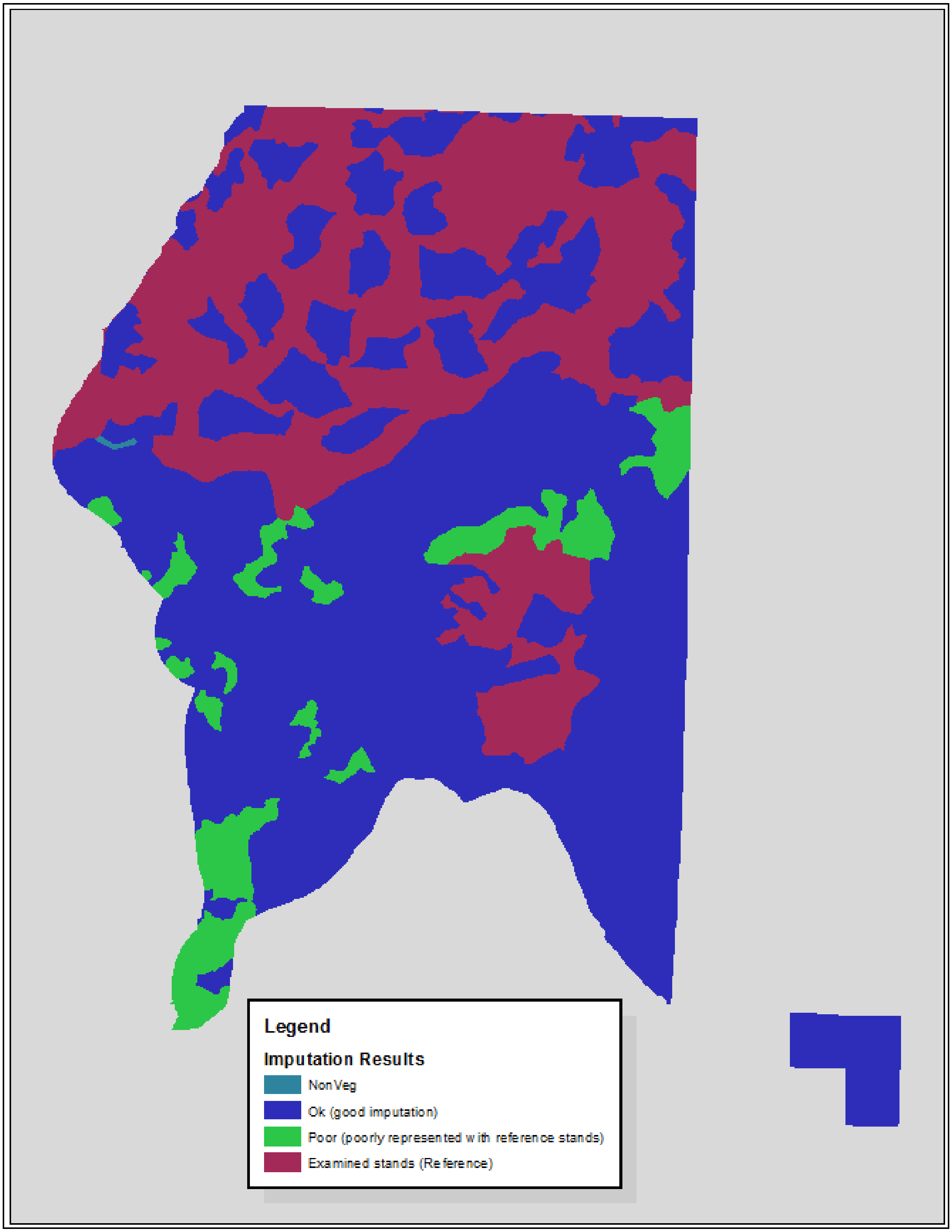
Young Forest Multi Strata (YFMS). In this stage of forest development, three or more tree layers are present as a result of canopy differentiation or because new cohorts of trees got established. This class consists of a broken or discontinuous overstory layer with a mix of tree sizes present (large trees are absent or scarce); it provides high vertical and horizontal diversity. Less than 10 trees per acre less than 21” in diameter.This class is also referred to as “multi-stratum, without large trees” (USDA Forest Service 1995).

Old Forest Multi-Stratum (OFMS). Many age classes and vegetation layers mark this structural class and it usually contains large, old trees. Decaying fallen trees may also be present that leave a discontinuous overstory canopy. On Cool Moist sites without recurring underburns, multi-layer stands with large trees in the uppermost stratum may be present. 10 or more trees per acre that are 21” in diameter

Old Forest Single Stratum (OFSS). Much age classes but only a single fairly distinct overstory layer marks this structural class and it usually contains large, old trees. Decaying fallen trees may also be present that leave a discontinuous overstory canopy. The diagram shows a single-layer stand of ponderosa pine that evolved with high frequency, low-intensity fire 10 or more trees per acre that are 21” in diameter

Sources/Notes: Based on Oliver and Larson (1996) and O’Hara and others (1996). Modified, Tatum 2006

Appendix *- Nearest Neighbor Run- Metadata



```
Nearest Neighbor Run Database:
E:\AnalyzerTest1\ArcGIS10.1\Region_6\Deschutes\des_nn2704_t2\NearestNeighbor\Runs\SO
_MSN_C1_C2\NnSettings.mdb
Nearest Neighbor Y (Intensive) Data Database:
E:\AnalyzerTest1\ArcGIS10.1\Region_6\Deschutes\des_nn2704_t2\BaseData\FVS_Summary.md
b
Nearest Neighbor X (Extensive) Data Database:
E:\AnalyzerTest1\ArcGIS10.1\Region_6\Deschutes\des_nn2704_t2\NearestNeighbor\Bin\NnE
xtData.mdb


FSVeg Spatial Data Analyzer Nearest Neighbor Report

2015-02-12 15:24:19
Dataset: des_nn2704_t2
Method: msn
Scenario: SO_MSN_C1_C2
Description: Most-Similar Neighbor(MSN)  imputation for the SO FVS Variant.  Uses
the MSN statistical process to impute the data.

Use the following information to evaluate the run.
As with any statistical package, care should be taken when using the results.

=====================================================================================
---
                                MSN Evaluation Info
=====================================================================================
===
For a statistically valid run, it is recommended that all of these
checks pass before using the output of this imputation run.

CHECK 1: Check for Statistical Validity

Number of variates used is: 9
                Variate check: Adequate number of variates

CHECK 2: Check for the Quality of the Run

Canonical R Squared of 1st variate is:  0.967274485104924
                Canonical R Squared of the 1st Variate Check:
                                Adequate canonical R squared of the 1st variate.

Canonical R Squared of the First Variate, evaluation information:
 Value    . Evaluation Information
 < .6     | Not suggested for use without further review.
 .6 - .7  | Generally for broad general use without further review.
 .7 - .8  | Generally considered adequate for project use.
 > .8     | Generally considered dependable for EA modeling.

=====================================================================================
===
                                MSN Run Statistics
=====================================================================================
===
Reference Stand Info:
Number of reference stands used is: 154
There were 10 notably large differences among reference observations.
This represents 6.49 percent of the 154 references.
Threshold value calculated: 1.71

Threshold value used: 1.59
Imputed Stand Info:
Number of target imputations is: 1466
```

There were 155 notably large differences between reference and target observations.
This represents 10.57 percent of the 1466 imputations.

Total number of forested (reference and imputed) stands: 1620

Percentage of stands:
Below threshold = 90.43%
Above threshold = 9.57%

90.43 of the stands were well represented by the imputation run. The remaining percentage did not have similar reference stands, hence all available reference options could be statistically poor. These stands will be displayed as 'Poor' on the map.

Threshold values are used to help indicate which stands may not be well represented by the imputed values. The analyst should carefully evaluate all imputed stands based on local knowledge with particular care to stands labeled 'Poor' on the map.

Applies to reference stands only:
Mean Y RMSDS - Evaluation Variables: 0.895193987701582
Generalized Y RMSD - Evaluation Variables: 1.17166909709659

==

MODEL RESULTS INFORMATION

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Use the Mean RMSDS values to compare the quality of this imputation to that of other Scenarios.

Root Mean Squared Differences

RMSD = Root Mean Squared Difference
RMSDS = Root Mean Squared Difference Scaled

*** Evaluation Variables ***
These variables are reference stand based. They are important variables chosen by the analyst for the project to be analyzed.
They are used by the imputation run as the goal for prediction. Smaller RMSDS values indicate better predictability of the variable.
This set of variables remains static for ALL scenario (nearest neighbor) runs in this imputation dataset project.

Y (Intensive)

	RMSD	RMSDS
ZVOL_MH	26.8288410	0.579062
ZVOL_WF	484.1177338	0.645819
Canopy_Density	0.0505825	0.671861
SDI	105.6059202	0.685573
TCuFt	1537.7434872	0.714201
ZVOL_DF	71.0956195	0.716619
BA	44.2393872	0.735385
ZVOL_ES	64.3705584	0.748101
MCuFt	1415.0299501	0.762804
BdFt	8937.1611537	0.784425
CCF	62.2800546	0.800648
Crown_Index	8.8107420	0.809126
Tpa	695.0173267	0.817242
TopHt	11.2131069	0.834196
Total_Cover	10.4097856	0.839059

```
QMD                 2.0707926 0.850180
ZVOL_LP           169.9917177 0.889998
ZVOL_PP           477.2603290 0.933560
ZVOL_NF             4.5582755 1.000000
ZVOL_RA            10.2631826 1.000000
ZVOL_WB            17.2647966 1.009971
ZVOL_WJ             9.5045812 1.013665
Fuel_Mod1           1.0751019 1.058454
Surf_Flame_Sev      1.5092093 1.078248
Canopy_Ht           7.9253825 1.128400
Torch_Index        51.5402483 1.239491
ZVOL_AF           213.3914410 1.305129
ZVOL_AS            28.8117572 1.414214
ZVOL_OH             0.0000000       NA

Mean Y RMSDS: 0.895193987701582
Generalized Y RMSD:   1.17166909709659

X (Extensive)
                         RMSD    RMSDS
Elev_m            141.0441626 0.558434
utmy             5107.8015905 0.689398
LSat8_B2_m        262.6662698 0.854400
LSat8_B3_m        301.6872738 0.861847
LSat8_B5_m        872.6793099 0.868525
LSat8_B10_m      1578.4526371 0.870197
LSat8_B11_m      1124.0192546 0.883357
LSat8_B4_m        555.4578089 0.922843
LSat8_B6_m       1735.1807930 0.976940
LSat8_B7_m       1482.2697963 0.988203
Prendvi_m           0.0519329 1.028425
utmx             3369.3278675 1.032980
Tancrv_sd           0.0827361 1.067706
Dur_m             231.0058576 1.080755
LSat8_B5_sd       243.8194420 1.086062
Slope_m             5.7261671 1.097536
Tancrv_m            0.0918315 1.106247
LSat8_B2_sd        67.1958044 1.118680
Cti_m               1.1331337 1.125613
Slpcosasp_sd        0.0456555 1.146473
LSat8_B3_sd        85.4453451 1.155701
Inso_m         106649.7561073 1.161212
LSat8_B6_sd       411.9719065 1.172966
Slpcosasp_m         0.1379086 1.184032
LSat8_B10_sd      321.9966155 1.185881
LSat8_B11_sd      227.8303217 1.186483
Elev_sd            14.1957761 1.190967
Inso_sd         33215.1384404 1.196396
Plncrv_m            0.0672691 1.224921
Cti_sd              0.4185160 1.225564
LSat8_B7_sd       352.3761815 1.242397
Slope_sd            1.9848516 1.242641
Dur_sd             91.5074879 1.264714
Plncrv_sd           0.0676611 1.267342
LSat8_B4_sd       154.8363671 1.277034
Slpsinasp_sd        0.0557510 1.395736
Slpsinasp_m         0.1192304 1.472049
Prendvi_sd          0.0122432       NA

Mean X RMSDS: 1.09217987119384
Generalized X RMSD:   1.22301930462468

==================================================================================
```

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*** Fit Variables ***
These variables are the actual variables used in calculating this imputation. These variables may change based on the imputation method used. They can also be manipulated by the analyst to test different scenarios to improve overall imputation results.

Y (Intensive):

	RMSD	RMSDS
LogVOL_WF	1.529332	0.508272
LogVOL_DF	0.685524	0.527404
LogVOL_MH	0.618822	0.594365
LogVOL_PP	1.266396	0.606459
LogSDI	0.289656	0.639858
SDI	105.605920	0.685573
LogBA	0.277699	0.698138
LogCCF	0.317008	0.722510
BA	44.239387	0.735385
LogBdFt	0.507162	0.742729
LogVOL_AF	1.102121	0.750699
LogTpa	0.669464	0.755002
LogVOL_LP	1.718386	0.775067
LogVOL_ES	0.893721	0.780152
BdFt	8937.161154	0.784425
CCF	62.280055	0.800648
Tpa	695.017327	0.817242
TopHt	11.213107	0.834196
Total_Cover	10.409786	0.839059
LogTopHt	0.156861	0.841640
QMD	2.070793	0.850180
LogQMD	0.325625	0.926672
LogVOL_NF	0.325183	1.000000
LogVOL_RA	0.390586	1.000000
LogVOL_WJ	1.180232	1.054613
LogVOL_WB	0.576275	1.135831
LogVOL_AS	0.630508	1.414214

X (Extensive):

	RMSD	RMSDS
Elev_m	141.0441626	0.558434
dd0	60.5005255	0.572399
mmin	0.1993198	0.575144
mtcm	0.3469443	0.581945
mtwm	0.5247398	0.594290
dd5	99.5165350	0.595096
d100	7.5903203	0.595111
mmax	1.0454841	0.604069
utmy	5107.8015905	0.689398
gsp	28.2329267	0.721324
gsdd5	48.6268736	0.763452
sday	2.3717733	0.811747
LSat8_B2_m	262.6662698	0.854400
LSat8_B3_m	301.6872738	0.861847
LSat8_B5_m	872.6793099	0.868525
LSat8_B10_m	1578.4526371	0.870197
LSat8_B11_m	1124.0192546	0.883357
LSat8_B4_m	555.4578089	0.922843
ffp	5.2262986	0.945783
LSat8_B6_m	1735.1807930	0.976940
LSat8_B7_m	1482.2697963	0.988203

```
pSite              6.2370011 1.022573
Prendvi_m          0.0519329 1.028425
utmx            3369.3278675 1.032980
Tancrv_sd          0.0827361 1.067706
Dur_m            231.0058576 1.080755
LSat8_B5_sd      243.8194420 1.086062
Slope_m            5.7261671 1.097536
Tancrv_m           0.0918315 1.106247
LSat8_B2_sd       67.1958044 1.118680
Cti_m              1.1331337 1.125613
Slpcosasp_sd       0.0456555 1.146473
LSat8_B3_sd       85.4453451 1.155701
Inso_m        106649.7561073 1.161212
LSat8_B6_sd      411.9719065 1.172966
Slpcosasp_m        0.1379086 1.184032
LSat8_B10_sd     321.9966155 1.185881
LSat8_B11_sd     227.8303217 1.186483
Elev_sd           14.1957761 1.190967
Inso_sd        33215.1384404 1.196396
Plncrv_m           0.0672691 1.224921
Cti_sd             0.4185160 1.225564
LSat8_B7_sd      352.3761815 1.242397
Slope_sd           1.9848516 1.242641
Dur_sd            91.5074879 1.264714
Plncrv_sd          0.0676611 1.267342
LSat8_B4_sd      154.8363671 1.277034
Slpsinasp_sd       0.0557510 1.395736
Slpsinasp_m        0.1192304 1.472049
Prendvi_sd         0.0122432       NA

=========================================================================================
===
                              MODEL RUN INFORMATION
=========================================================================================
===
This section lists X (Extensive) and Y (Intensive) variable usage
in the model run including what was selected for use, what was
used, and what was dropped.

X (Extensive) = These variables represent data populated in
        all polygons (e.g. slope, aspect, etc.)
Y (Intensive) = These variables represent data populated in sampled
        polygons (e.g. tpa, ba, etc.)


Fit Variables Selected In Scenario
X (Extensive):
 [1] Cti_m        Cti_sd       d100         dd0          dd5
 [6] Dur_m        Dur_sd       Elev_m       Elev_sd      ffp
[11] gsdd5        gsp          Inso_m       Inso_sd      LSat8_B10_m
[16] LSat8_B10_sd LSat8_B11_m  LSat8_B11_sd LSat8_B2_m   LSat8_B2_sd
[21] LSat8_B3_m   LSat8_B3_sd  LSat8_B4_m   LSat8_B4_sd  LSat8_B5_m
[26] LSat8_B5_sd  LSat8_B6_m   LSat8_B6_sd  LSat8_B7_m   LSat8_B7_sd
[31] mmax         mmin         mtcm         mtwm         Plncrv_m
[36] Plncrv_sd    Prendvi_m    Prendvi_sd   pSite        sday
[41] Slope_m      Slope_sd     Slpcosasp_m  Slpcosasp_sd Slpsinasp_m
[46] Slpsinasp_sd Tancrv_m     Tancrv_sd    utmx         utmy

Y (Intensive):
 [1] BA         BdFt       CCF        LogBA      LogBdFt    LogCCF
 [7] LogQMD     LogSDI     LogTopHt   LogTpa     LogVOL_AF  LogVOL_AS
[13] LogVOL_DF  LogVOL_ES  LogVOL_LP  LogVOL_MH  LogVOL_NF  LogVOL_OH
[19] LogVOL_PP  LogVOL_RA  LogVOL_WB  LogVOL_WF  LogVOL_WJ  QMD
```

```
[25] SDI           TopHt        Total_Cover Tpa

Fit Variables Dropped due to NULL Data:
Y (Intensive):
                None.
X (Extensive):
                None.

Fit Variables Dropped due to Lack of Variance:
Y (Intensive):
                None.
X (Extensive):
                None.

Fit Variables Dropped by Model
Y (Intensive):
[1] LogVOL_OH

X (Extensive):
                None.

Fit Variables Used by Model (Excludes Variables Dropped)
X (Extensive):
 [1] Cti_m         Cti_sd        d100          dd0           dd5
 [6] Dur_m         Dur_sd        Elev_m        Elev_sd       ffp
[11] gsdd5         gsp           Inso_m        Inso_sd       LSat8_B10_m
[16] LSat8_B10_sd LSat8_B11_m   LSat8_B11_sd LSat8_B2_m    LSat8_B2_sd
[21] LSat8_B3_m    LSat8_B3_sd   LSat8_B4_m    LSat8_B4_sd   LSat8_B5_m
[26] LSat8_B5_sd   LSat8_B6_m    LSat8_B6_sd   LSat8_B7_m    LSat8_B7_sd
[31] mmax          mmin          mtcm          mtwm          Plncrv_m
[36] Plncrv_sd     Prendvi_m     Prendvi_sd    pSite         sday
[41] Slope_m       Slope_sd      Slpcosasp_m   Slpcosasp_sd Slpsinasp_m
[46] Slpsinasp_sd Tancrv_m      Tancrv_sd     utmx          utmy

Y (Intensive):
 [1] BA          BdFt        CCF         LogBA       LogBdFt     LogCCF
 [7] LogQMD      LogSDI      LogTopHt    LogTpa      LogVOL_AF   LogVOL_AS
[13] LogVOL_DF   LogVOL_ES   LogVOL_LP   LogVOL_MH   LogVOL_NF   LogVOL_PP
[19] LogVOL_RA   LogVOL_WB   LogVOL_WF   LogVOL_WJ   QMD         SDI
[25] TopHt       Total_Cover Tpa


========================================================================
Warning(s) and/or error(s) produced during this NN imputation (by yaImpute):
Warning message:
In yai(y = intFitTable, x = extFitTable, method = yaiMethod,  ... :
  y variables with zero variance: LogVOL_OH

========================================================================
```

Appendix *- Northwest Forest Plan Standard and Guideline C-44 Analysis. Provide for retention of old-growth fragments in watersheds where little remains

The Deep Canyon (1/5th field) watershed consists of a wide range of biophysical environments that include inherent soil limitations to tree growth, from alpine meadows to xeric shrublands and as such only a portion of the watershed can support development of trees let alone large trees that develop into an assemblage that becomes old growth habitat for late successional species (Craigg et al. 2015).

The old growth fragments/ patches[1] in the Deep Canyon Watershed and Melvin Butte Project area are displayed in Appendix F and total 1,188 acres at the watershed scale. Six hundred and sixty-two of these acres are within the Melvin Butte project boundary (Table 38, 39). In addition, these old growth patches/fragments in the watershed are disproportionally located to public (primarily Forest Service lands) and/or to biophysical environments more productive in nature (Simpson 2007, Appendix F, Table 38).

Over ½ (about 56%) of the entire watershed's large tree patches/ fragments are contained within Melvin Butte project area (Appendix F). The large tree patches/ fragments were further analyzed among the differing Melvin Butte project treatment descriptions areas which are presented below (Table 39). This analysis was chosen in order to demonstrate meeting Standard and Guideline C-44 of the Northwest Forest Plan.

Retention of Melvin Butte old growth patched/ fragments are being met in several ways under either action alternatives. The below acre proportions come from the 662 acres found within Melvin Butte project area. These are broken out by Alternative 2 treatment type

1) Retention strategy and other areas (ex. Three Creek) that are absent of thinning treatment.
    a. 33% of the old growth fragments/ patches found within Melvin Butte project area are in these areas.
2) Restriction of treatments to prescribed fire and/or 8"dbh thinning limit in Prescribed Fire treatment units.
    a. 30% of the old growth fragments/patches found within Melvin Butte project area are in these treatment areas and would not be impacted due to nature of small understory tree thinning and use of low intensity prescribed fire.
3) Retention of all old growth ponderosa pine clumps/ areas within the 160 acre Dwarf Mistletoe Units when they meet clump designation quota (at least 4 old growth ponderosa pine within a connected 66ft distance between trees).
    a. Less than 1% of the old growth fragments/ patches within Melvin Butte area are contained in this treatment type and by Lidar determination process[15] (and above parameter) provides retention of old growth.

[1] Old growth patch size/ fragment determination came from a Lidar process of using a 30meter raster in order to determine large tree assemblages (number of large (>21"dbh) trees per 30 meter grid) that meet (or exceed) the Interim Old Growth Guide1993. Areas determined by Lidar analysis and consist of a height derived diameter. See correlation variables including diameter in Appendix E.

4) Unit by unit silvicultural implementation prescriptions that describe retention of old growth structure, composition (and accentuation) where present. Retention to include old growth ponderosa pine and old growth white fir and other species (where present) to a frequency that maintains large tree structure/ frequency across stands and maintains the definition as described in the Interim Old Growth Definitions (USDA 1993).
    a. 30% of the old growth patches/ fragments acres are contained in the Thinning treatment description areas.
        i. All prescriptions call for the retention and/or accentuation of old growth trees to maintain or exceed definitions (VanPelt 2008, USDA 1993).
    b. Less than 4% of the old growth patches/ fragments acres are contained in the Mixed Conifer Group Opening treatment areas.
        i. All prescriptions call for retention of old growth ponderosa pine. Any and all openings would maintain ponderosa pine tree composition and structure.
    c. Less than 2% of the old growth patches/ fragments are contained in the Plantation treatment areas.
        i. No old growth will be cut in plantations; this number represents trees detected on the boundaries of these areas. Boundary trees may be pruned if infected with dwarf mistletoe.
    d. All other treatment areas do not contain these old growth patches/ fragments

Alternative 2 and Alternative 3 are nearly identical in retention proportions and needs met for Standard and Guideline C-44. Difference is “Thinning Treatment” (Item 4a above in this section) increases to 35% as those old growth patches/fragments acres from Dwarf Mistletoe and Mixed Conifer treatments are reclassified to “Thinning Treatment”. Under Alternative 3, Items 3 and 4b (above in this section) are not applicable. Thus unit by unit silvicultural prescriptions (Item 4ai above in this section) describes how old growth fragment/ patch retention would occur in these combined areas.

Table**. Acres and proportions of the large tree patches/ fragments among different “subareas” within the Deep Canyon watershed.

	Acres	*Old growth fragments/patches acres (Lidar determined based on large trees/acre)*	*Proportion of area with old growth patches/fragments (%)*
Deep Canyon watershed	97,509	1,188	1.2%
Applicable assessment area due to pertinent biophysical environment	60,712	1,188	2.0%
FS land with pertinent biophysical environments	49,601	1105	2.2%
Private land with pertinent biophysical environments	47,908	83	0.2%

Table *. Acres and proportions of the large tree patches/ fragments among the Melvin Butte treatment types.

	Total Acres	*Old growth fragments/patches acres (Lidar determined based on large trees/acre)*	*Proportion of Melvin Butte old growth fragment/ patches acres by Alt 2. Treatment type[2] acres*
Melvin Project	5,375	662	N/A
Retention strategy, no treatment and no thinning treatment areas	940	222	33%
Plantations	1174	13	2%
Prescribed fire (includes small tree thinning)	809	201	30%
Dwarf Mistletoe	160	2	0%
Mixed Conifer Group Openings	835	24	4%
Scenic Views Enhancement	240	0	0%
Lodgepole pine improvement	249	0	0%
Thinning	998	201	30%

[2] NOTE-this table is identical among Alternatives EXCEPT acre contribution from Mixed Conifer Group Openings AND Dwarf Mistletoe are added to the Thinning treatment type under Alternative 3.

Appendix *- Single Tree based Lidar vs. CVS plot Estimates by size class for TPA, TBA, QMD and Avg DBH

Trees per Acre Estimates by size class on 306 CVS Plots

Highlighted t Stats are different at the 95% Level

t-Test: Two-Sample Assuming Unequal Variances 1-5" dbh

	CVS_TPA	*Lidar4_TPA*
Mean	370.6404255	136.4600328
Variance	131882.6949	16386.27071
Observations	282	305
Hypothesized Mean Difference	0	
df	345	
t Stat	10.25574613	
P(T<=t) one-tail	5.10527E-22	
t Critical one-tail	1.649282305	
P(T<=t) two-tail	1.02105E-21	
t Critical two-tail	1.966863909	

t-Test: Two-Sample Assuming Unequal Variances 5-10" dbh

	CVS_TPA	*Lidar4_TPA*
Mean	100.4134228	96.85063333
Variance	7149.01854	4452.385431
Observations	298	300
Hypothesized Mean Difference	0	
df	564	
t Stat	0.571740964	
P(T<=t) one-tail	0.283862631	
t Critical one-tail	1.647559815	
P(T<=t) two-tail	0.567725262	
t Critical two-tail	1.964179027	

t-Test: Two-Sample Assuming Unequal Variances 10-15" dbh

	CVS_TPA	*Lidar4_TPA*
Mean	34.67144128	35.18838488
Variance	838.7086225	727.5574274
Observations	281	291
Hypothesized Mean Difference	0	
df	564	
t Stat	-0.220728186	
P(T<=t) one-tail	0.412691982	
t Critical one-tail	1.647559815	
P(T<=t) two-tail	0.825383964	
t Critical two-tail	1.964179027	

t-Test: Two-Sample Assuming Unequal Variances 15-20"dbh

	CVS_TPA	*Lidar4_TPA*
Mean	12.2565019	14.37524528
Variance	198.9590677	239.5564379
Observations	263	265
Hypothesized Mean Difference	0	
df	522	
t Stat	-1.644223654	
P(T<=t) one-tail	0.050366043	
t Critical one-tail	1.647777944	
P(T<=t) two-tail	0.100732085	
t Critical two-tail	1.964518942	

t-Test: Two-Sample Assuming Unequal Variances 20-25"dbh

	CVS_TPA	*Lidar4_TPA*
Mean	6.864881517	8.060434783
Variance	172.8110525	107.3230013
Observations	211	207
Hypothesized Mean Difference	0	
df	398	
t Stat	-1.033773875	
P(T<=t) one-tail	0.150934811	
t Critical one-tail	1.648691174	
P(T<=t) two-tail	0.301869622	
t Critical two-tail	1.965942324	

t-Test: Two-Sample Assuming Unequal Variances 25-30" dbh

	CVS_TPA	*Lidar4_TPA*
Mean	4.143203593	4.519210526
Variance	39.01663711	50.41719937
Observations	167	152
Hypothesized Mean Difference	0	
df	302	
t Stat	-0.500088524	
P(T<=t) one-tail	0.30868847	
t Critical one-tail	1.649914828	
P(T<=t) two-tail	0.617376939	
t Critical two-tail	1.967850227	

Total Basal Area per Acre Estimates for 1 hectare CVS Plots

Highlighted t Stats are different at the 95% Level

t-Test: Two-Sample Assuming Unequal Variances 1-5" dbh

	CVS_TBA	*Lidar4_TBA*
Mean	17.8556361	7.259096506
Variance	303.550322	48.44050589
Observations	282	305
Hypothesized Mean Difference	0	
df	363	
t Stat	9.534287233	
P(T<=t) one-tail	1.12084E-19	
t Critical one-tail	1.649062137	
P(T<=t) two-tail	2.24168E-19	
t Critical two-tail	1.966520641	

t-Test: Two-Sample Assuming Unequal Variances 5-10" dbh

	CVS_TBA	*Lidar4_TBA*
Mean	27.90859839	28.8628731
Variance	512.0043135	401.5890685
Observations	298	300
Hypothesized Mean Difference	0	
df	586	
t Stat	-0.545811087	
P(T<=t) one-tail	0.292701756	
t Critical one-tail	1.647458056	
P(T<=t) two-tail	0.585403512	
t Critical two-tail	1.964020461	

t-Test: Two-Sample Assuming Unequal Variances 10-15" dbh

	CVS_TBA	*Lidar4_TBA*
Mean	27.59199408	28.1768581
Variance	567.6735798	463.991389
Observations	281	291
Hypothesized Mean Difference	0	
df	560	
t Stat	-0.307624567	
P(T<=t) one-tail	0.379241199	
t Critical one-tail	1.647579178	
P(T<=t) two-tail	0.758482399	
t Critical two-tail	1.964209198	

t-Test: Two-Sample Assuming Unequal Variances 15-20" dbh

	CVS_TBA	*Lidar4_TBA*
Mean	19.56828208	23.1814323
Variance	513.5973882	646.4279888
Observations	263	265
Hypothesized Mean Difference	0	
df	520	
t Stat	-1.724032016	
P(T<=t) one-tail	0.042648198	
t Critical one-tail	1.647789211	
P(T<=t) two-tail	0.085296396	
t Critical two-tail	1.964536501	

t-Test: Two-Sample Assuming Unequal Variances 20-25" dbh

	CVS_TBA	*Lidar4_TBA*
Mean	18.42555065	21.60534771
Variance	1280.541067	788.7643468
Observations	211	207
Hypothesized Mean Difference	0	
df	397	
t Stat	-1.011660425	
P(T<=t) one-tail	0.156158308	
t Critical one-tail	1.648700863	
P(T<=t) two-tail	0.312316616	
t Critical two-tail	1.965957428	

t-Test: Two-Sample Assuming Unequal Variances 25-30" dbh

	CVS_TBA	*Lidar4_TBA*
Mean	16.71275404	18.36593919
Variance	644.7485986	845.705406
Observations	167	152
Hypothesized Mean Difference	0	
df	301	
t Stat	-0.538504749	
P(T<=t) one-tail	0.295313315	
t Critical one-tail	1.649931694	
P(T<=t) two-tail	0.590626631	
t Critical two-tail	1.967876531	

QMD Estimates by size class on 306 CVS plots

Highlighted t Stats are different at the 95% Level

t-Test: Two-Sample Assuming Unequal Variances 1-5" dbh		
	CVS_QMD	*Lidar4_QMD*
Mean	3.124100322	3.176148974
Variance	0.400261379	0.161550857
Observations	282	305
Hypothesized Mean Difference	0	
df	469	
t Stat	-1.178960143	
P(T<=t) one-tail	0.119505901	
t Critical one-tail	1.648109068	
P(T<=t) two-tail	0.239011801	
t Critical two-tail	1.965034989	

t-Test: Two-Sample Assuming Unequal Variances 5-10"dbh		
	CVS_QMD	*Lidar4_QMD*
Mean	7.19421051	7.368768361
Variance	0.515190781	0.291913138
Observations	298	300
Hypothesized Mean Difference	0	
df	552	
t Stat	-3.358203484	
P(T<=t) one-tail	0.000419302	
t Critical one-tail	1.647618745	
P(T<=t) two-tail	0.000838605	
t Critical two-tail	1.964270856	

t-Test: Two-Sample Assuming Unequal Variances 10-15"dbh		
	CVS_QMD	*Lidar4_QMD*
Mean	12.03309547	12.08616591
Variance	0.579071282	0.303580875
Observations	281	291
Hypothesized Mean Difference	0	
df	509	
t Stat	-0.952561572	
P(T<=t) one-tail	0.170632186	
t Critical one-tail	1.647852769	
P(T<=t) two-tail	0.341264373	
t Critical two-tail	1.964635549	

t-Test: Two-Sample Assuming Unequal Variances 15-20" dbh		
	CVS_QMD	*Lidar4_QMD*
Mean	17.00305224	17.03371057
Variance	0.479954934	0.405332618
Observations	263	265
Hypothesized Mean Difference	0	
df	522	
t Stat	-0.52934128	
P(T<=t) one-tail	0.298396879	
t Critical one-tail	1.647777944	
P(T<=t) two-tail	0.596793757	
t Critical two-tail	1.964518942	

t-Test: Two-Sample Assuming Unequal Variances 20-25" dbh		
	CVS_QMD	*Lidar4_QMD*
Mean	22.14176069	22.00116601
Variance	0.950512772	0.648114646
Observations	211	207
Hypothesized Mean Difference	0	
df	404	
t Stat	1.60894777	
P(T<=t) one-tail	0.054204436	
t Critical one-tail	1.648634049	
P(T<=t) two-tail	0.108408872	
t Critical two-tail	1.965853275	

t-Test: Two-Sample Assuming Unequal Variances 25-30" dbh		
	CVS_QMD	*Lidar4_QMD*
Mean	27.21090076	26.98034685
Variance	1.108094343	0.711710825
Observations	167	152
Hypothesized Mean Difference	0	
df	312	
t Stat	2.167181654	
P(T<=t) one-tail	0.015488641	
t Critical one-tail	1.649752124	
P(T<=t) two-tail	0.030977282	
t Critical two-tail	1.967596497	

Average DBH Estimates for 306 CVS Plots

Highlighted t Stats are different at the 95% Level

t-Test: Two-Sample Assuming Unequal Variances 1-5" dbh		
	CVS_AvgDBH	*Lidar4_AvgDBH*
Mean	2.958289881	3.021192084
Variance	0.469779373	0.162609905
Observations	282	305
Hypothesized Mean Difference	0	
df	447	
t Stat	-1.341374753	
P(T<=t) one-tail	0.090239956	
t Critical one-tail	1.648269625	
P(T<=t) two-tail	0.180479911	
t Critical two-tail	1.965285234	

t-Test: Two-Sample Assuming Unequal Variances 5-10"dbh		
	CVS_AvgDBH	*Lidar4_AvgDBH*
Mean	7.085147667	7.250806512
Variance	0.509009685	0.284763619
Observations	298	300
Hypothesized Mean Difference	0	
df	550	
t Stat	-3.213619665	
P(T<=t) one-tail	0.000693761	
t Critical one-tail	1.647628817	
P(T<=t) two-tail	0.001387522	
t Critical two-tail	1.964286551	

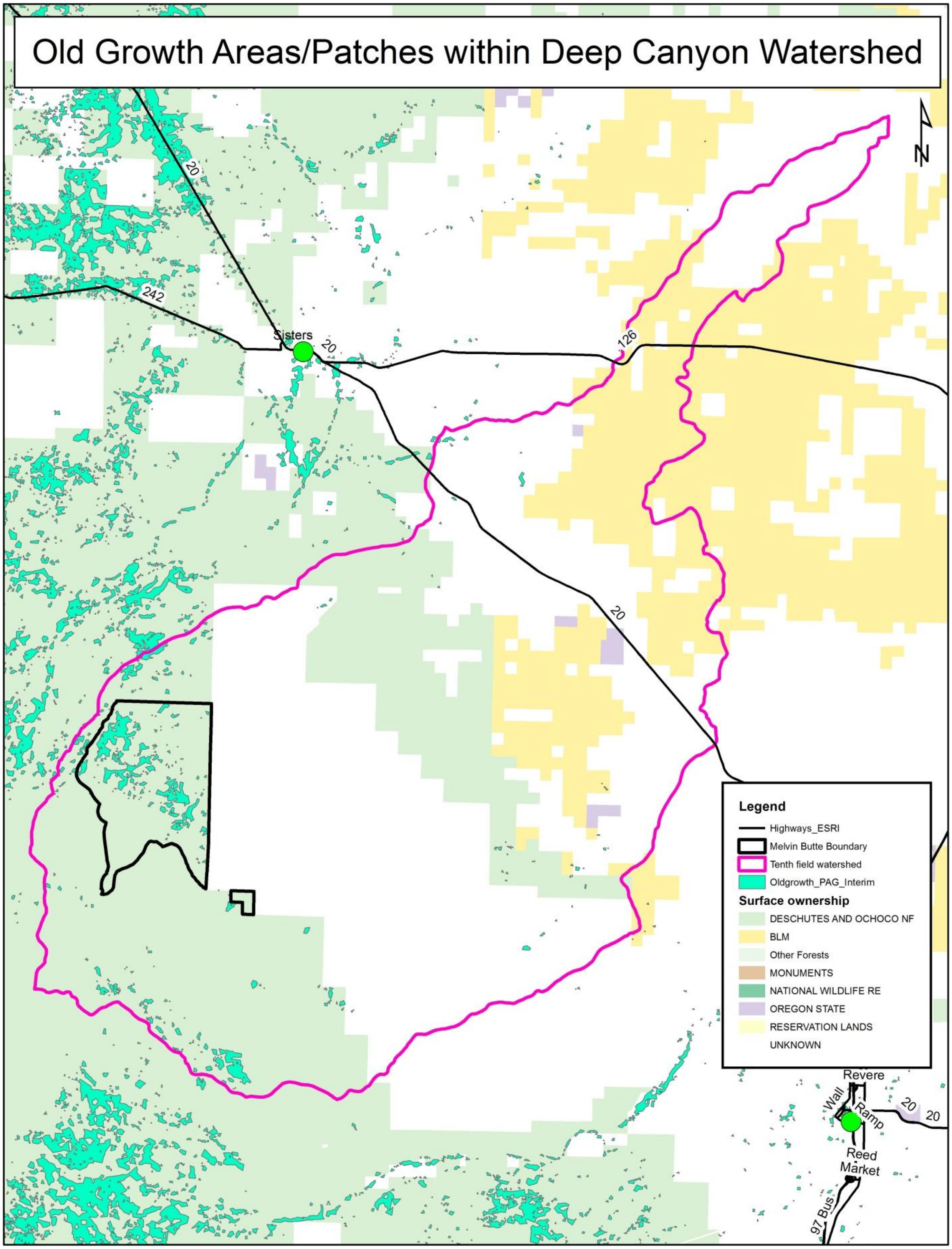
t-Test: Two-Sample Assuming Unequal Variances 10-15" dbh		
	CVS_AvgDBH	*Lidar4_AvgDBH*
Mean	11.97217533	12.01505557
Variance	0.577570809	0.29352981
Observations	281	291
Hypothesized Mean Difference	0	
df	505	
t Stat	-0.77464995	
P(T<=t) one-tail	0.219454536	
t Critical one-tail	1.647876568	
P(T<=t) two-tail	0.438909071	
t Critical two-tail	1.964672639	

t-Test: Two-Sample Assuming Unequal Variances 15-20" dbh		
	CVS_AvgDBH	*Lidar4_AvgDBH*
Mean	16.95929056	16.98699133
Variance	0.470612234	0.394643242
Observations	263	265
Hypothesized Mean Difference	0	
df	521	
t Stat	-0.483778309	
P(T<=t) one-tail	0.314373239	
t Critical one-tail	1.647783567	
P(T<=t) two-tail	0.628746479	
t Critical two-tail	1.964527705	

t-Test: Two-Sample Assuming Unequal Variances 20-25" dbh		
	CVS_AvgDBH	*Lidar4_AvgDBH*
Mean	22.11570776	21.9698589
Variance	0.946344498	0.637749985
Observations	211	207
Hypothesized Mean Difference	0	
df	404	
t Stat	1.676760114	
P(T<=t) one-tail	0.047181472	
t Critical one-tail	1.648634049	
P(T<=t) two-tail	0.094362944	
t Critical two-tail	1.965853275	

t-Test: Two-Sample Assuming Unequal Variances 25-30" dbh		
	CVS_AvgDBH	*Lidar4_AvgDBH*
Mean	27.19139361	26.95802043
Variance	1.105058684	0.697603855
Observations	167	152
Hypothesized Mean Difference	0	
df	311	
t Stat	2.204518185	
P(T<=t) one-tail	0.014109952	
t Critical one-tail	1.649767922	
P(T<=t) two-tail	0.028219904	
t Critical two-tail	1.967621133	

Appendix F- Locations of Lidar-derived old growth patches/ fragments within the Deep Canyon watershed and Melvin Butte Project area



Appendix *- Dwarf Mistletoe Background

Dwarf Mistletoe Spread Potential

Dwarf mistletoes possess one of the most effective, hydrostatically controlled, explosive mechanisms of seed dispersal known to flowering plants (Hawksworth 1977, USDA Agriculture Handbook 709, 1996). Maximum dispersal distance is about 48 feet, but dispersal distances of 30 feet or less are more typical. Studies of three species of dwarf mistletoe have indicated about 40 percent of dispersed seeds are intercepted by trees (Hawksworth 1965b). For example, an adjoining tree within 18 to 27 feet of an infected host would intercept 90 percent of the seeds dispersed in its direction. Germination is largely determined by environmental factors, but most mistletoe germinates in the spring following fall dispersal. Once infection is established, an incubation period of two to five years elapses before young shoots appear and the cycle of infection continues. In single-storied stands, spread is estimated to be two to three feet per year. Spread in multi-storied stands (which is largely the stand structure in the Melvin Butte area) is more rapid because the understory trees are exposed to infection from the overstory (Forest Insect and Disease Leaflet, USDA 2003).

Prior management practices beyond fire exclusion may have also played a role in increasing the rate of infection. Early harvest practices emphasized removal of mature, large diameter ponderosa pine which were at high risk of attack by western pine beetle. Smaller, understory trees were often retained. Where fire would have killed many of those that were infected with western dwarf mistletoe, they now would remain.

Severity of infection from dwarf mistletoe with a Dwarf Mistletoe Rating (DMR) scale from 1 (light) to 6 (severe). Individual trees with a DMR of 3 or less and stands with an average rating of less than or equal to 2 have a higher likelihood of being effectively managed through unevenaged thinning treatments and attaining old forest structure.

Roth and Barrett (1985) investigated the response after thinning ponderosa pine in central Oregon. Dependent upon the site potential of the stand, they found that if crowns enlarged at a faster rate than dwarf mistletoe propagates, thinned trees would grow quite productively. They found that while the population of dwarf mistletoe plants increases dramatically following thinning, it does so at about the same rate as the increase in the size of the tree crown. The ratio of number of plants to crown size stays relatively constant. The net result was no detectable height growth in an even-aged stand. Barrett and Roth (1986) also investigated the response of a thinned stand of mistletoe-infected immature 40- to 70-year old ponderosa pine, and response of a thinned stand of mistletoe-infected immature ponderosa pine that had recently had a removal of mature mistletoe-infected overstory. Conclusions of these studies demonstrate that by regulating stand density, trees in even-aged stands are able to tolerate light to medium levels of dwarf mistletoe and grow at or near rates of uninfected trees.

Given its persistent nature, the best way to control dwarf mistletoe is to prevent infection by protecting young tree regeneration (Conklin 2000), through stand replacement disturbance or clearcutting. Spot treatment for protecting regeneration in irregular, and uneven-aged sites can help provide a more sustainable condition by reducing abundance or delaying infection. In uneven-aged stands with numerous scattered infections such as those found within the project area, regenerative conditions in the absence of disturbance or treatment deteriorate over time (USDA PNW BMZ-96-07, 1996). Where infection severity renders stand conditions unmanageable, more aggressive stand-replacing harvests may be called for (Gill and Hawksworth 1954; Hawksworth 1978). Regeneration occurring in openings under an uneven-aged management approach can be achieved through group selection, which controls mistletoe more effectively than single-tree selection, where infection can still occur beside infected trees. Treatment blocks should include groups of infected trees and a buffer of 100 feet beyond visibly infected trees. To minimize invasion of young pine stands by dwarf mistletoe from bordering infected trees, the ratio of perimeter to area of clearcuts should be minimized, with cut openings roughly circular, rather than long and narrow (Forest Insect and Disease Leaflet, USDA 2003). Two- to four-acre gaps in heavily infected uneven-aged stands are the recommended size to allow ponderosa pine regeneration to be free to grow in a relatively infection-free environment.

Table 3 and Table 4 illustrate findings from a 1990 Hawksworth study ("How Long Do Mistletoe-Infected Ponderosa Pine Live?") on a relationship of tree growth and mortality in Arizona ponderosa pine to dwarf mistletoe infection. In the study, DMR was tracked by diameter class over a 30 year period. From the data in the tables, notice that the mean dwarf mistletoe rating increases faster for trees under nine inches than for those over nine inches. Also, those trees under nine inches with a DMR of 5 or 6 did not survive 30 years (Table 1).

Table *. Trees/acre of Ponderosa Pines and 32-year Intensification in Relation to Original Dwarf Mistletoe Infection Rating Class and Diameter (from Hawksworth, 1990 on Arizona Ponderosa Pine)

Tree Diameter				
	Under 9 Inches in Diameter		9 inch Diameter and Over	
1950 DMR Class	Trees/acre Alive in 1982	Mean DMR in 1982	Trees/acre Alive in 1982	Mean DMR in 1982
0	88	1.8	199	1.1
1	19	4.3	53	3.7
2	14	5.1	40	4.9
3	4	5.5	25	5.2
4	2	6.0	16	5.4
5	0	-	15	5.8
6	0	-	3	6.0

Table *2. Trees/acre of Ponderosa Pines and Percent Survival after 11, 20, and 32 years in Relation to Original Dwarf Mistletoe Infection Rating Class and Diameter (from Hawksworth, 1990 on Arizona Ponderosa Pine)

Tree Diameter								
Under 9 Inches in Diameter					9 Inches Diameter and Over			
1950 DMR Class	Trees/acre Alive in 1982	Percent Alive			Trees/acre Alive in 1982	Percent Alive		
		1961	1970	1982		1961	1970	1982
0-1	119	99	97	90	259	98	98	97
2-3	42	90	81	43	78	91	90	83
4-5	15	60	40	13	93	82	63	33
6	6	16	16	0	58	48	36	5

Retained in a passive management scenario without a frequent fire regime, dwarf mistletoe severity increases within the stand and spreads laterally to uninfected areas of the stand at a rate of one or two feet per year (Hawksworth 1996). This relationship is magnified for stands with a considerable uneven-aged structure and a large tree component. These effects are intensified, or more pronounced when the overstory trees are infected, causing not only a lateral, but also a vertical vector for spreading infection onto susceptible understory trees. Infected overstory trees are less likely to develop into mature trees as shown in Table 3, especially if the level of infection is severe (rated 5 or 6). Severe infection levels also serve as ladder fuel (facilitating transition from a low-intensity ground fire into a more lethal crown fire event), reduce the vigor of the older trees through competition, and make them more susceptible to attack from western and mountain pine beetle. These factors taken together reduce the potential for a stand to achieve old forest structure in a portion of the stand where the overstory infection occurs.

Figure 9 illustrates growth of trees correlated to the dwarf mistletoe rating over the course of 100 years. (Growth rates from Hawksworth, USDA Agriculture Handbook 709, 1996). An assumed linear growth rate of an uninfected tree that takes 100 years to reach 21 inches is compared to expected growth rates of differing DMR severity. Dwarf mistletoe not only reduces the number of trees that reach 21 inches but also increases the time it takes for individual trees to reach that size.

Figure *. Relative Growth of Ponderosa Pine of differing Dwarf Mistletoe Infection Ratings